

CHAPTER II RECONNAISSANCE

A. GENERAL

Land stations in the tropical Pacific are sparse. Although additional observing units have been activated during the past year and more are expected to be located at strategic sites in the future, the stations will continue to remain widely scattered. Ships which transmit weather observations are usually concentrated along the shipping lanes which do not pass through the areas of formation and development of tropical systems. Also, ships which are near a tropical cyclone will normally take evasive action as soon as the first warning is received. The pictures from the ESSA and NIMBUS weather satellites have proven to be a tremendous aid, especially in initial detection of suspect areas. However, satellites cannot report the wind, pressure, and other important meteorological parameters needed to properly analyze a tropical cyclone. Aerial reconnaissance thus remains the only method to provide sufficient surface and upper air data for complete and proper analysis of a tropical cyclone.

Reconnaissance aircraft can remain in the vicinity of a storm to provide an accurate position and to report storm characteristics such as eye shape, intensity, and extent of cloud patterns. By taking dropsondes or making ascent or descent soundings, the aircraft obtains the lapse rate profile to the surface, heights of standard levels, sea level pressures, and temperature and dew point at any level.

The accuracy of tropical warnings is directly related to the quality and quantity of reconnaissance data received from the aircraft. Continuous surveillance of tropical systems is of the utmost importance in order to insure that warnings are issued in time to facilitate proper preparations for safeguarding life and property.

B. RECONNAISSANCE RESPONSIBILITY

During 1967 two squadrons were assigned the responsibility of tropical cyclone reconnaissance to meet the requirements of the Joint Typhoon Warning Center, Guam. These squadrons were the U. S. Navy Airborne Early Warning Squadron One (VW1), equipped with the EC121K aircraft based at the Naval Air Station, Agana, Guam and the U. S. Air Force 54th Weather Reconnaissance Squadron (54WRS), equipped with WC-130 aircraft based at Andersen Air Force Base, Guam.

C. EVALUATION OF DATA

During the 1967 season, four fixes per day were normally scheduled on typhoons and tropical storms. Tropical Depressions were

scheduled for one or more fixes per day depending on location, potential, and feasibility of radar coverage.

In general, low (1500ft or below) or intermediate (700mb) level fixes were made by VW1 at 1000Z and 1600Z, and intermediate level fixes were made by the 54WRS at 2200Z and 0400Z. High level (500mb) fixes were made on storms in the vicinity of high terrain. In addition to the fixes, both squadrons flew synoptic and investigative flights throughout the year.

Aerial reconnaissance can be divided, according to data gathered, into three categories: peripheral data, eye data from penetration, and eye data from radar.

Peripheral data is all information reported enroute to and outside the eye of the storm. It includes hydrometeor description, sea level pressure, pressure-height, a complete description of clouds including types, amount and heights of bases and tops, flight altitude winds, temperature, dew point, and surface winds. This same type of data is provided on all synoptic tracks and investigations.

Eye data from penetration includes all information reported in peripheral data plus eye size, shape, description, slope, cloudiness, maximum flight level wind, maximum temperature inside and outside the eye, and maximum surface wind. Remarks which might be of help to the forecaster such as feeder band description, and direction and speed movement of the center are also included.

Eye data from radar provides a description of the radar eye and its location, including description of spiral bands and height and width of the wall cloud. Also included is the aircraft position at the time the radar observation is taken and the maximum observed winds when available.

On all eye messages a center selection evaluation is made. An evaluation of "Positive", "Fair", or "Poor" is given along with an estimate of the navigational accuracy of the fix and the type of navigation used by the aircraft. These were used by JTWC as a guide in evaluating fix accuracy. When radar fixes are made from a considerable distance, attenuation can distort the radar image; therefore, the distance of the aircraft from the storm center must be considered when evaluating the radar fix.

During 1967, daylight penetrations were made on all but a few of the most severe storms. When possible, EC121K aircraft also penetrated the storms for night fixes. Many of the night penetrations were made at 1500 feet or below, especially when the storms were too weak for radar coverage. Location of the circulation center with the aid of the aircraft landing lights was not uncommon when the center could not be determined by other means.

AIRCRAFT RECONNAISSANCE DATA
(Number of Fixes and Investigations)

1961	1962	1963	1964	1965	1966	1967
350	496	465	772	666	674	845*

* 112 No Credit (see Paragraph E) not included.

112
957

In addition there were 484 synoptic tracks flown by the two squadrons during 1967.

The information from the aircraft was continually checked for consistency and accuracy. Where possible, JTWC graphs and other aids were used to check and compare data with previous reports. Verification was immediately requested from the observing aircraft on any apparent discrepancy in the data.

D. COMMUNICATIONS

The primary means of communications between ground stations and reconnaissance aircraft was voice single sideband. Andersen Airways (AIE2), Guam was the primary air to ground station for 54WRS aircraft. The Joint Typhoon Warning Center "Enjoyment" circuit was the primary air to ground station for VW1 aircraft for relay of weather messages. Clark Airways (AIC2), Republic of the Philippines, Fuchu Airways (AIF2), Japan, and Kadena Airways (AID2), Okinawa, were the secondary air to ground stations. Data received by AIE2 were relayed to JTWC by local teletype circuit SDE 9. This circuit also connects VW1, 54WRS, NCS Guam, and Naval Air Station, Agana, Guam. Data received by AIC2, AIF2, and AID2 were relayed to JTWC through the Defense Communications System.

When aircraft were in contact with AIE2 or JTWC "Enjoyment" circuit, reports were normally received by JTWC in sufficient time to allow the forecaster to make a comprehensive study of the information prior to warning time. The extensive use of these two means of communications made it operationally feasible for JTWC to adjust the fix times to two hours prior to warning time vice three hours as in previous years. This provided more current and timely data for the issuance of warnings. However, when the aircraft had to communicate through one of the secondary stations there were many cases of excessive delay in receipt of the eye data. In some instances it was not received until after warning time.

A comparison of the JTWC "Enjoyment" circuit delay times with the next most reliable means, Andersen Airways via the SDE 9 circuit, revealed an average delay time difference of 23 minutes in favor of "Enjoyment".

The average delay time from the aircraft to JTWC direct was 30 minutes. This includes the delay in the aircraft by the meteorologist, and the time for JTWC to copy the complete eye data message. The maximum delay over the JTWC circuit was 3 hours, 41 minutes and the minimum delay just a few minutes. Receipt of the eye data message in less than 10 minutes from fix time was not uncommon when the flight meteorologist expedited the message and communications were good. One of the more noticeable advantages of "Enjoyment" was the elimination of excessive delay in receiving data from remote areas such as the South China Sea. NCS Guam, by using high gain antennas especially suited for receipt of data from particular geographical areas, was able to provide communications with the aircraft even under adverse conditions. Another distinct advantage of direct communications with the aircraft was the ability to clarify doubtful data with minimal delay. Also, relay of the latest meteorological data directly to the flight meteorologist on investigative flights often provided more useful information and permitted the aircraft to remain in the area longer for a thorough investigation, since late information such as satellite readout gave a more exact location of the suspect area.

The constant use of the "Enjoyment" circuit required an excessive number of man hours by JTWC personnel in direct communications with the aircraft and subsequent relay of the weather reconnaissance data through the Defense Communications System. The limited number of personnel assigned to JTWC and the lack of qualified communications personnel precludes the continued use of this system.

A method to improve existing communications and also preclude the need for additional personnel to work the "Enjoyment" circuit was requested by JTWC to CINCPAC. If approved, the 54WRS weather monitor would be tasked with the processing and retransmission of all RAINPROOF VWL weather reconnaissance observations. In addition, discrete frequencies would be assigned for the relay of weather reconnaissance observations to preclude preemption by other airways traffic.

The addition of a telephone line from Andersen Airways to JTWC with the associated monitoring equipment has been approved. This will enable JTWC to monitor incoming weather reconnaissance data simultaneously with the receipt by the 54WRS weather monitor and provide direct phone patch capability with the reconnaissance aircraft when required.

The following statistics show the delays between time of fix and time of first receipt at JTWC. The methods used in getting the fix to JTWC are shown for comparison.

DELAY IN RECEIPT OF RECONNAISSANCE FIX DATA FOR 1967

METHOD	NUMBER OF CASES	MAX DELAY TIME	MIN DELAY TIME	AVG DELAY TIME
SDE9	346	2 HR 44 MIN	0 HR 18 MIN	0 HR 52 MIN
ENJOYMENT	460	3 HR 41 MIN	0 HR 04 MIN	0 HR 30 MIN
OTHER	70	11 HR 20 MIN	0 HR 05 MIN	1 HR 24 MIN

Table II-1 contains some revealing statistics on communications delays encountered in 1967 along with figures from previous years for comparison.

A COMPARISON OF DELAY TIME WITH PREVIOUS YEARS

	1964	1965	1966	1967
MAX DELAY TIME	60 HRS 45 MIN	60 HRS 09 MIN	4 HRS 33 MIN	11 HRS 20 MIN
AVG DELAY TIME	1 HR 14 MIN	1 HR 05 MIN	1 HR 02 MIN	0 HR 43 MIN
MIN DELAY TIME	8 Minutes	9 Minutes	"Few Minutes"	"Few Minutes"
% OF EYE MESSAGES DELAYED MORE THAN 1 HOUR	59%	39%	38%	16%
NUMBER OF FIXES RECEIVED AFTER WARNING TIME	46	34	30	23*
% RECEIVED AFTER WARNING TIME	8%	6%	5%	3%*

* 1967 FIXES SCHEDULED 2 HOURS VICE 3 HOURS PRIOR TO WARNING TIME PRIOR TO 1967.

TABLE II-1

E. SUMMARY OF RECONNAISSANCE SUPPORT

In an effort to make the crediting of the reconnaissance effort more objective and meaningful, a system was devised in 1965 to credit fixes and investigations. The same system, with minor changes, was used during the 1966 and 1967 seasons. First of all, the problems of why a fix was early, late or missed completely, although of interest and concern to JTWC, belong to the Tropical Cyclone Reconnaissance Coordinator (TCRC). The time of warning and inherent delay from scheduled fix times were the determining factors used in the crediting scheme. Obviously, it would be desirable to have the fix made as near warning time as possible, and in the past it was necessary to have the fix times scheduled 3 hours prior to warning time because of communications delays. However, more rapid communications during 1967 permitted JTWC to adjust these fix times to 2 hours prior to warning time. This usually allowed ample time to digest the information after receipt of the data. The crediting system is described below.

DEFINITIONS OF FIX CREDITS

<u>CLASS</u>	<u>DEFINITION</u>	<u>FIX CRITERIA</u>
1	Full Credit	From 1 hour before to $\frac{1}{2}$ hour after levied time.
2	Full Credit	Aircraft in area requested within 1 hour before to $\frac{1}{2}$ hour after levied time but unable to locate a center.
3	Early/Late	Center located 1 to $1\frac{1}{2}$ hours before or $\frac{1}{2}$ to 2 hours after levied time.
4	Very Early/Very Late	Greater than $1\frac{1}{2}$ hours before or more than 2 hours after levied time.
5	Attempted but missed fix	Recon provided some useful peripheral data but no fix was made. Reasons may include clearance problems, mechanical trouble, low fuel, etc.
6	Missed Fix	Missed fixes not falling into any category above.
7	Full Credit	Fix made on investigative flight or synoptic track.
8	Full Credit	Investigative flight, no fix made.
9	No Credit	Preliminary or intermediate fix made between scheduled fixes.

This system, although as objective as possible, requires subjective evaluation of some fixes. For example, an aircraft could be in the area assigned on time, but unexpected storm acceleration could make the cyclone too distant to be reached within normal fix time limits. In this case, full credit is given with no penalty for being late.

Applying the above system for the 1967 season, the following statistics are obtained:

EVALUATION OF TIMELINESS OF RECONNAISSANCE FOR 1967

<u>Class</u>	<u>Number</u>
1	668
2	24
3	17
4	12
5	4
6	12
7	43
8	77
9	112